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SOME EAST SUSSEX OLIGOCHÆTS.

By the Rev. Hilderic Friend, F.R.M.S.

While treating of the distribution of British Annelids (1) * in this Journal, I gave in April, 1913 (vol. xvii., ser. 4, pp. 151–2), a list of the *Lumbricidæ* of Sussex. In the same volume I also described some new species of *Henlea* (pp. 81–91), while in other articles in the 'Zoologist' and the 'Journal of the Royal Microscopical Society' I had added still further to our knowledge of the subject. Up till the present, however, no attempt has been made to bring under review our knowledge of the entire order of Oligochæts. As I have, so far as I am aware, been the only naturalist to study the subject, the following records are entirely based on my own observations in the county.

It will be necessary, for the sake of completeness, to recapitulate some of my earlier statements (7). My researches commenced in November, 1890, and were continued in March, 1892 (2). The *Lumbricidæ* collected on these occasions numbered fifteen species. In addition, a number of *Tubificidæ* and *Enchytræidæ* were examined, but many of these have not as yet been reported on.

In 1897 I compiled a list of Sussex Earthworms (3) so far as then known, and enumerated sixteen species; *Octolasium profugum* being the latest addition to the county records. For many years, owing to my residence at a distance and my other researches, no further progress was made, but in 1911 *Helodrilus*

* The numbers in brackets refer to the Bibliography.

oculatus was discovered. In December of that year I had to visit Hastings, and was fortunate enough to discover many interesting things. The number was increased during a stay of some days in Sussex in July, 1912, while a visit to Sedlescombe in August, 1913, enabled me to make yet other discoveries. Practically all of those which were new to science have already been described in this or other journals; but there are a few species which are at present unknown in any other part of the kingdom, to which attention must be drawn before a list of all known species is drawn up. Hastings itself has proved to be peculiarly rich in Enchytræids and Tubificids; but, owing to the paucity of lakes, ponds, and streams, there seem to be very few *Naididæ* or allied forms, though these abound around London.

Of the Henleas which I described in this Journal (1913, pp. 81–91) a considerable number have been found in Sussex, and in several instances the descriptions were based upon material collected at Hastings in December, 1911. My most successful hunting-ground on that occasion was a bit of waste land between the sea and the Bexhill road near the Bopeep Station. One or two bridges are found here under which the streamlets flow into the sea, and it was found that Enchytræids delighted in the moist, cool situations provided by the wall on the one side and the earth, frequently enriched by decaying seaweed and other vegetable matter, on the other. Here I found many specimens of *Henlea marina*, *H. curiosa*, *H. arenicola*, *H. heterotropa*, and others new to science.

Alexandra Park also proved to be a very valuable hunting-ground. The decaying leaf-mould usually harbours a number of interesting Lumbricids, such forms as *Dendrobæna subrubicunda*, *D. arborea*, *Eisenia fœtida*, *Lumbricus rubellus*, and *L. castaneus* being the most frequent. In a manure-heap I found, in addition to many Brandlings and *Enchytræus albidus*, a form of *Eisenia* which is uncommon. Unfortunately the material in this case was immature, and I have not hitherto been able to obtain a fresh supply for its determination. The matter is, however, worthy of mention, as showing that the possibilities of further discoveries are not yet exhausted.

The mud on the margin of the pool in the park proved to be

very rich in material, and both here and in the runnels which lead to it I have found material which has not up till the present occurred in any other locality. One or two of the species merit special notice.

Ilyodrilus meganymphus, Friend (1912, J. R. M. S., p. 289); the locality unfortunately not then recorded), belongs to the Tubificids. Its specific name is due to the large spherical cœlomic corpuscles (nymphus = lymphus, whence our term lymphatic). In this respect the creature resembles *Rhyacodrilus*, which is a link between the *Tubificidæ* and the *Naididæ* (4). The chloragogen cells begin in segment 4, which is in advance of the usual position. Curiously enough, while it simulates *Rhyacodrilus* in the matter of cœlomic corpuscles, it closely resembles the red-blooded Enchytræids in the vascular system. This is of peculiar interest, seeing that the blood-vessels in the *Tubificidæ* are usually much more profuse and the system much more complex than is the case with the Enchytræids. It is the discovery of such unusual forms as these which at once makes systematic lists and definitions a problem, and yet throws such a flood of light on the evolution of species.

Haplotaxis gordioides (G. L. H.). In 1896 I gave an account (5) of a worm which had been sent to me by a medical man in Essex. It was new to science, and was named *Dichæta curvisetosa*, Friend. The name was changed in 1899 to *Phreoryctes dichætus*, Friend. Up till the present no further specimens have been found. Michaelsen (10) in 1899 published an account of *P. gordioides*, and included the Essex species, in spite of the great differences between it and the type. In 1900 (9) he issued his valuable monograph on Oligochæts, and called the worm *Haplotaxis gordioides*, and still persisted in including the Essex form. On December 21st, 1911, I had the good fortune to find the worm which bears this name in Alexandra Park, Hastings, and was able instantly to recognize it and to see how greatly it differs from *P. dichætus*. Thus, at the present time we have two species of *Haplotaxidæ* in England; in addition to a third well worm found in East Anglia but not yet described.

Tubifex heuscheri, Bret., was also collected near the park. It has not been found elsewhere in Great Britain up till the present time; making the third unique species.

It should be noted that my observations are limited to a triangle, the base of which extends from Hastings to Pevensey, and the two sides joining those places with Robertsbridge.

On the occasion of my last visit to Sussex in August, 1913, I spent an hour in examining the Annelid fauna under moss and liverwort by a bridge over the little stream which flows through the meadows or "brooks," as they are locally called in the picturesque village of Sedlescombe, and here I found some species of Enchytræids which had not previously been recorded for Sussex. It may be of interest to note that one of these was *Chamædrilus chlorophilus*, Friend (6). Though first described from material collected in Derbyshire, I found, on looking up my notes, that I had already found it in Sussex, but had not been able to identify it, and so had put my description aside to await fuller light. Thus it happens that Sussex has the honour of giving us one of the first reliable records for this hitherto unknown Annelid.

These preliminary observations must suffice to prepare the way for the systematic list. The families and genera are for convenience of reference arranged in the order adopted by Prof. Michaelsen (9). Unfortunately there has, up till the present, been no reliable record for either the family *Æolosomatidæ* or *Naididæ*. These contain many species of microscopic worms which inhabit the mud or vegetation of fresh or brackish waters. We begin, therefore, with the *Tubificidæ*, another family of freshwater worms, but of larger dimensions.

Tubificidæ.

Setæ of various kinds; male pore on eleventh or twelfth segment, with spermathecal pore on adjoining segment. Upwards of a dozen known genera. Michaelsen (9), pp. 36 *seq.*, 522 *seq.* The Sussex genera at present on record are limited to three, *viz.* *Limnodrilus*, *Ilyodrilus*, *Tubifex*. I believe *Sænuris*, *Clitellio*, and *Psammoryctes* might be found if carefully sought. *Rhyacodrilus* also, which I have shown (4) to be more nearly related to the *Tubificidæ* than the *Naididæ*, is found in Essex, and should occur under similar conditions in Sussex.

1. *Limnodrilus hoffmeisteri*, Clap.—Michaelsen (9), p. 43. Alexandra Park, Hastings, June, 1912. Not uncommon in the county by streams and in pools.

2. *L. udekemianus*, Clap.—Michaelsen (9), p. 45. Alexandra Park, Hastings, June, 1912, and elsewhere. First collected for certain at Amberstone Grange, August 30th, and at Battle and Sedlescombe, August 31st, 1911.

3. *L. papillosus*, Friend.—1912, Friend (6), pp. 276–7. "First found at Kew, August, 1911, and since discovered in gleanings from the neighbourhood of Battle and Hurstmonceaux, Sussex." Hastings, June 20th, 1912.

4. *L. aurantiacus*, Friend.—1911, Friend (8), p. 414. "My notes show that this species is widely distributed in the South of England, from Derbyshire to Kew and Sussex." Friend (6), p. 275.

5. *Ilyodrilus meganymphus*, Friend.—1912, Friend (6), p. 289. Described from specimens found in runnel in Alexandra Park, below the Bohemia entrance. Found December 21st, 1911.

Other species of *Ilyodrilus* occur in Sussex, but the *Tubificidæ* of Great Britain are under careful revision, and until my work is somewhat more advanced, it would only result in confusion to give further records here.

6. *Tubifex tubifex* (Müller).—Michaelsen (9), p. 48. Friend (6), pp. 291–2. *Tubifex* is common in Sussex as in most parts of England, but hitherto several different species, and even genera, have been confused under this name. I have taken different forms in Alexandra Park, at Battle, Dallington, Hurstmonceaux, and elsewhere. The same observation is true of *Tubifex* which is made of *Ilyodrilus*. I have notes made many years ago which suggest that *Psammoryctes* was at least once collected by me in Sussex. The muddy banks of rivers, as at Shoreham, would be prolific hunting-grounds, but have never yet been worked. *Heterochæta costata*, Clap., and other very interesting Annelids are sure to abound there, as they do in similar localities on the Thames estuary.

6*a*. *T. heuscheri*, Bret.—Near Kite's Nest, Hastings, June, 1912; only British record.

Lumbriculidæ.

Sigmoid setæ either forked or pointed, four pairs on each segment. Girdle in a very advanced position (segments 3–7). Ten or a dozen known genera, of which only about one half are

as yet known in Great Britain. *Rhynchelmis limosella*, Hoffm., which was found in Hants in 1913 is almost sure to occur, and one or two species of *Stylodrilus* must also be indigenous. Hitherto, however, only one genus, and but one species of that, is on record.

7. *Lumbriculus variegatus* (Müller).—Michaelsen (9), p. 58. First found by me in Pevensey Marsh in 1892. Taken in Alexandra Park, Hastings, June 20th, 1912. Not uncommon among water-weeds in streams and ponds or lakes.

ENCHYTRÆIDÆ.

Setæ present, except in *Achæta*, straight, sigmoid, or bent near the internal extremity. Girdle usually on segment 12; but sometimes advanced three or four segments (as in *Chamædrilus* and *Buchholzia*). Spermathecæ opening between segments 4 and 5; either free within the cœlom or more frequently attached to the intestine. Dorsal pores in one genus (*Fridericia*). Blood usually red in the Pachydrylid section, otherwise colourless or yellowish. A very large and interesting family, concerning which I have written much during the past three years, especially in the 'Journal of the Royal Microscopical Society' and in these pages (1). One new genus (*Chamædrilus*, Friend) is at present known only in Britain, where, however, it is widely distributed. To the genus *Henlea*, as well as to *Fridericia*, I have recently added many new species. So far as our present knowledge goes, England has more Enchytræids than any other country. I give the Henleas alphabetically.

8. *Henlea arenicola*, Friend.—1912 (6), p. 586. Found at Bopeep, Hastings, December 21st, 1911, and first described from the material there collected.

9. *H. curiosa*, Friend.—1912 (6), p. 588. Same locality and date as foregoing.

10. *H. fragilis*, Friend.—1912 (6), p. 588. Same locality and date.

11. *H. fridericioides*, Friend.—1912 (6), p. 587. Same locality and date.

12. *H. heterotropa*, Friend.—1912 (6), p. 589. Same locality and date.

13. *H. hibernica*, Southern.—1907, 'Irish Naturalist,' vol. 16,

pp. 70–1, with plate. First Sussex record, Sedlescombe "brooks," August, 1913.

14. *H. lampas*, Eisen.—Michaelsen (9), p. 70. Friend (1), 1911, p. 465; (8), p. 321; (6), p. 584. The species as emended found at Hastings, December 21st, 1911.

15. *H. marina*, Friend.—1912 (6), pp. 589–591, with illustrations. Bopeep, December 21st, 1911.

16. *H. rhætica*, Bretscher. — 1912, Friend (6), pp. 593–5. Hastings as before, and again November 25th, 1912.

17. *H. triloba*, Friend.—1912 (6), p. 596. From the Bopeep station, December 21st, 1911.

18. *Buchholzia appendiculata* (Buch.).—Michaelsen (9), p. 72. Hastings, June, 1912; Sedlescombe "brooks," August, 1913.

19. *B. focala*, Friend. — 1914, J. R. M. S. (now being published). Hastings, December 21st, 1911.

20. *B. tenuissima*, Friend. -- 1914, J. R. M. S. (see 19). Collected June 12th, 1912, Alexandra Park, Hastings.

I have recently revised and extended our records for this genus, adding some new British species; but am at present unable to decide whether or not a further species is to be added to the Sussex list. My Sedlescombe material is as instructive and interesting as it is perplexing, and must receive further study.

21. *Marionina* sp.—Not adult; Hastings, December 21st, 1911. This group of red-blooded Enchytræids is very extensive, and it is no exaggeration to say that, if the coast and estuaries of Sussex were to be carefully examined, a score of species at least could be collected. The genus, with its ally *Lumbricillus*, is under revision.

22. *Enchytræus albidus*, Henle.—The commonest species of this genus. Found everywhere in well-rotted manure. Very abundant in old manure-heap, Hastings, December 21st, 1911. See Friend (3) for earlier record.

23. *E. buchholzi*, Vejd. Sedlescombe, 1897. See last note.

24. *E. minimus*, Bret.—Michaelsen (9), p. 92. Hastings, December 21st, 1911.

25. *E. nigrinus*, Bret.—Hastings, December 21st, 1911. This is one of several species which have been discovered since Michaelsen's Monograph (9) was published. Other species await determination.

26. *Fridericia michaelseni*, Bret.—Michaelsen (9), p. 100. One of the most widely distributed species of this genus. Hastings, December 21st, 1911.

27. *F. bulbosa*, Rosa, and a variety or allied form at the same place and time. Also Sedlescombe, August, 1913.

28. *F. variata*, Bret. Hastings, same time and place as foregoing.

29. *Fridericia* sp.—One of the bisetose forms, not yet sufficiently diagnosed. Sedlescombe "brooks," August 16th, 1913.

This list of species belonging to the genus *Fridericia* leaves much to be desired. Nearly one hundred species are known to science, about half of which are British, and forty or fifty species ought easily to be found in Sussex. The genus *Achæta* is at present unknown in this county.

30. *Chamædrilus chlorophilus*, Friend. — 1912, Friend (6), pp. 257 *seq.* This interesting Annelid appears at present to be unknown outside the British Isles. Hastings, June, 1912; Sedlescombe "brooks," August 16th, 1913.

Haplotaxidæ.

31. *Haplotaxis gordioides* (G. L. H.).—Michaelsen (9), p. 108. Quite distinct from *H.* (*Dichæta*) *curvisetosa*, Friend ('Essex Nat.' vol. 9, p. 110), with which Michaelsen confuses it. I found the genuine *H. gordioides* at Hastings, December 21st, 1911; a day memorable for the many discoveries made during a couple of hours spent between Bopeep and Alexandra Park.

Lumbriculidæ.

32. *Allurus* (*Eiseniella*) *tetrædrus*, Sav. — Michaelsen (9), p. 471. Not known in November, 1890. Friend (7), p. 22. First record for Sussex, 1892. Friend (2), p. 123. Since found in many parts of the county.

33. *Eisenia fœtida*, Sav.—Michaelsen (9), p. 475. First Sussex record, 1891. Friend (7), p. 21. Found everywhere in manure. In the Gensing Gardens I once found a variety which was peculiar, but I cannot at present put hands on my memoranda.

34. *E. rosea*, Sav. (=*A. mucosa*, Eisen). First Sussex record, March, 1892. Friend (2), p. 124. In May, 1892, my mother

collected for me at Dallington, the consignment consisting of seven species (*Allurus tetrædrus*, *Eisenia rosea*, *A. chlorotica*, *A. caliginosa*, *B. constrictus*, *L. rubellus*, and *L. castaneus*), the specimens of *E. rosea* being marked, "very typical."

35. *Allolobophora longa*, Ude. Friend (2), p. 123. First found at Dallington, March, 1892, and frequently since. More abundant in many places than the true Earthworm, with which it is often confused.

36. *A. caliginosa*, Sav. (forma *turgida*, Eisen). Friend (2), p. 124. Forma *trapezoides*, Hurstmonceaux, July 23rd, 1889.

37. *Aporrectodea chlorotica*, Sav.—With many aliases, some of which accompany the first record for Sussex, November, 1890. Friend (7), p. 21. Very common and widely distributed. Inside Pevensey Castle.

38. *Dendrobæna subrubicunda*, Eisen (= *rubida*, Sav.).—Friend (2), pp. 123–4. Very abundant, as a rule, in old manure and among leaf-mould. Alexandra Park, December 21st, 1911.

39. *D. arborea*, Eisen.—First found in Sussex, March, 1892. Friend (2), p. 123. Not common, but found again December 21st, 1911, in an old log on the shore at Bopeep.

40. *D. mammalis*, Sav. (=*celtica*, Rosa).—In tree-stump with the last at Dallington, March, 1892. Friend (2), p. 124. Rare; but found most frequently in road-scrapings which have "ripened."

41. *Helodrilus oculatus*, Hoffm.—A worm of peculiar interest. By the side of dykes at Boreham Bridge, by the Fish Market, Hastings, and on the way to Kite's Nest Farm; apparently generally distributed in Sussex.

42. *Bimastus eiseni*, Lev.—Apparently rare in Sussex. First record, March, 1892. Friend (2), pp. 123–4.

43. *B. constrictus*, Rosa.—The Sussex record for March, 1892 (Friend (2), p. 123), was the first for Great Britain. June, 1912, I found one specimen in a gutter beyond the Fish Market, Hastings, with *H. oculatus*, *L. rubellus*, and *A. chlorotica*.

44. *Octolasium profugum* (= *lacteum*, Oerley).—*Supra*, p. 81. Dallington; first and only Sussex record.

45. *Lumbricus rubellus*, Hoffm.—Friend (2), p. 123. Generally distributed.

46. *L. castaneus*, Sav. (= *purpureus*).—March, 1892. Friend (2), p. 123. First record, November, 1890. Friend (7), p. 21.

47. *L. festivus*, Sav. (= *rubescens*, Friend).—Near fir plantation between Brightling and Dallington, March, 1892. (2), p. 123. Not common in Sussex.

48. *L. terrestris*, L.—Friend (7), p. 20. Dallington, Hurstmonceaux, and elsewhere.

In addition to the foregoing, I have to record the occurrence of a small tender worm at Ecclesbourne. It was found in July, 1912, but died before I could examine it alive. A second collection was made and preserved. No single example was adult, but it seemed undoubtedly to belong to the genus *Allurus*. Pending an opportunity of seeking for it again, I have named it *Allurus mollis*.

When we remember that a county like Nottingham, without a seaboard or estuary, and with hardly any hills, already records nearly a hundred Annelids, we cannot repress the suspicion that many new species await discovery in Sussex; and if two hours' work could in December, 1911, yield such rich results, what might we not expect if a steady and systematic search were carried out? I shall be glad of any assistance in this most important branch of research. Gleaning should be placed in tin boxes and addressed Pocklington, York.

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RELATIONSHIP OF SPECIES.

By H. Panton.

(Continued from p. 35.)

Referring to the cases of hybrids which (as Mr. Finn mentions) are hard to get, one might point out these may be hard to obtain in two ways, *viz.*:—either that it is difficult to get the parents to copulate, although conception is general when this does occur, or that although copulation is frequent no conception takes place. This point ought not to be lost sight of. Further, it has always seemed to me that it is far harder to get "uncongenial" hybrids (that is, sterile ones or aganesists) amongst lower animals than in the higher forms.

These sterile hybrids, I have noticed, appear to me to be the results of what one might term true miscegenation, that is, the parents show in general little natural liking for each other, and thus I take it that in lower forms with small brain capacity, intelligence as suggestive and incitant to copulation is wanting (and this intelligence seems largely operative in the production of horse and ass hybrids), and that therefore copulation is much rarer than in the higher forms.

Arguing by the above table of hybrids and congeneric habits, a hybrid, the parents of which mate readily, should be fertile, or again, when they show aversion or indifference, as happens where their habits are not congeneric, we might look for a sterile hybrid, and this is generally the case. I can conceive no explanation of this other than gradual evolutionary divergence of germ-plasm. It is suggested by certain authorities that in cases of infertility the physiological unit may be divergent or in dissimilar architectural multiples, and thus unable to combine; be this as it may (and we will refer to it later), it seems to me that it is always possible for the germ-plasm and outward form to run away from each other, *i. e.*, there being more divergence

or less *than is apparent*, and that although outward form has altered, the germ-plasm has not done so to the same extent or *vice versâ*, *i.e.*, as regards such practical powers as reproduction, and the congeniality and similarity this suggests.

One of the most puzzling cases that crop up is the lack of breeding results from such apparently connected birds as Carolina and Mandarin Ducks, as remarked by Finn, but we are getting rather in advance of our argument. To return: the infertility of agenesic hybrids is an unsolved problem, but it is possible that it is not essentially different to the infertility of inbred species.

Let us see what happens in this latter case, which is often carried out thus. Man takes an extreme type, and keeps breeding this type probably against any type that environment would select as the carrier of the germ-plasm. Man then produces what we may call an "uncongenial host," and the uncongeniality of the host probably adversely affects the vigour of the germ-plasm, thereby causing sterility. In short, Nature refuses to be led down the wrong path.

In the same way the hybrid bred from two very divergent forms is probably an uncongenial host, far indeed from the two forms Nature has been evolving: it probably has a twofold diverse "drive," and although the two parent forms have combined to produce the hybrid, and given so to speak the germ into its keeping, the hybrid combination, either from the general uncongeniality of the parental forms (to each other) that Nature has been producing, or its "driving" in two opposite directions through the influence of two different parental germ-plasmatic "driving" powers, cannot unite in full vigorous combination and undividedness to produce the perfect ripe filial germ-plasm; the ovum and spermatozoa never, I believe, in sterile forms becoming mature or "ripe." Admitting that the driving force of these two evolutionary parental forms be a bio-chemical one, the general explanation need not be different.

As sterility arises from interbreeding, as well as from violent crosses, it may be that it is, as stated above, from much the same cause, and if this were so it would be some evidence against the suggestion that the latter is due to a difference in the architectural unit as suggested by the school of Weismann.

To follow out interbreeding mercilessly, this procedure must

continue for generations, and as it is usually performed on animals, entails housing in the same way and feeding on (probably) a similar unvarying diet.

This must result in time in a deprivation to the system of anything tending to induce change or variety (with its probable benefits) in the germ-plasm.

This cannot be compared to the conditions which would obtain on the various islands, &c., where inbred creatures such as rabbits, &c., tend to multiply and increase. Here they get access to varying foods, which in their individuality they no doubt assimilate to varying degree, and where copulation with cousins many times removed is at least possible: both these causes ensuring some change in the system, however slight, from the stagnation that must result from the close inbreeding as practised by man, which cannot be compared to the natural evoluting inbreeding which takes place in the case of the rabbits quoted above, or such other examples as that of the red deer of New Zealand or the buffaloes of Australia. The latter move with the Unknown Cause of Evolution, the former against it, or rather tries to do so.

One may further reason that continued inbreeding may be likened to the prolonged subdivision of the germ-cells of primitive life, which goes on for a time, but ceases for some unknown reason at a certain point, unless some other strange cell combines with it to give it fresh vigour. Also, it seems likely that the infertility of divergent forms can be more easily explained by the growing dissimilarities of the germ-plasm.

It only seems reasonable that the germ-cell should require, as an inducement to give birth to a new life, a partner not too extreme, neither too satiate, nor too uncongenial. If, as one imagines, in the formation of cells, it is the union of the two separate individuals that causes the renewed productive powers, it would seem that inbred animals necessarily obstruct this process; the mating cells would in these types supply no new individuality to forward the above end. The rejection of a dissimilar and uncongenial unit can equally well be imagined.

Against the architectural theory: while mutations may and apparently do occur in varying degree as regards outward form, I am unable to find any definite or clear distinction between the

result of these and that which we might expect to be the outcome of less sudden variations (indefinite), and, moreover, the apparently graduating decline of fertility in the evoluting species given in the table of hybrids seems to render unlikely any such explanation as the above architectural theory suggests.

Any violent or abrupt change of germ-plasm seems in the face of these graduating results to be unusual, although one must admit this graduating evolution of germ-plasm is revealed in what appears to the eye as very apparent jumps as regards the outward form. However, are not the long-haired cavies as fertile with individuals of the parent type as these latter normally are *inter se*? and also the fertility of crosses of Zebu and European cattle, surely mutants showing a difference sufficiently great in jumping power to illustrate my meaning as to the congeniality of the germ-plasm as contrasted with the divergence of the outward form of these types. On the other hand, this graduating germ-plasm theory does at times receive a nasty jar, as notably in the instance of the beetle *Leptinotarsa rubicunda*, but perhaps I had better refer to this later on, and merely state now that, although this example seems at variance with our graduation theory of the germ-plasm, it is not unlikely that in some cases this jump in the plasm does take place; that the plasm does at times arrive more quickly at an uncongenial stage than appears general. This need not, however, force us to accept any such improbability or probability as an architectural physiological unit.

There is, of course, the question of blood parasites to be considered as bearing on sterility, which has been put forward as the cause of the sterility of certain species, such as some of the bison herds which show unsatisfactory breeding results. Upon matters such as these, and others such as the sterility of human races as the Tasmanians, one loses oneself in conjecture. The sudden sterility of the Tasmanians, for instance, appears, if not attributal to blood parasites or inbreeding, to be almost supernatural, psychological perhaps.

Another point, in which I imagine the more correct relationships of animals from similarity of germ-plasm as against structural changes are shown, is from the resemblance in the generative organs found in the various orders. While nutri-

ment, habit, and environment might be expected to very greatly affect the other organs, there would appear no very great reason why the form of the former should necessarily change, nor, broadly speaking, do they. Copulative organs and actions can have apparently no great reason for changing, nor would one expect them to be so liable to be influenced by evolution as bodily form, and they certainly appear to be the last to change; and in this respect the divergence in these organs between Platyrrhine and Catarrhine primates appears to be extremely suggestive of long separation and great divergence.

One feels bound to refer to divergence of results as shown in some reciprocal crosses between the same two species. Darwin refers to Kolreuter's experiments ('Origin of Species') thus:—

"*Miribilis jalapa* can easily be fertilised by the pollen of *M. longiflora*, and the hybrids thus produced are sufficiently fertile, but Kolreuter tried more than two hundred times, during eight following years, to fertilise reciprocally *M. longiflora* with the pollen of *M. jalapa*, and utterly failed."

An explanation of this curious fact appears hard to find. As, however, there does not appear to be any difference in the fertility of the hybrids that can be bred reciprocally, possibly some theory of "uncongeniality" might apply to these cases. When definite light is shed on such problems, one may expect to see much of the puzzle of hybridism laid bare. Considering the fact that many females are not fertile with certain males of their own species, it seems unwise to lay too much stress on the aberrant infertility of these reciprocal combinations.

If the theory of gradually separating forms shown by infertility is correct, some intermediate form should connect two others. No definite experiments to test this have been made, as far as I know.

Kolreuter, however, experimented with five forms or varieties of the common tobacco, and found that, although all these forms and their hybrids were perfectly fertile (even when tried reciprocally), one of these forms when crossed with *Nicotiana glutinosa* produced hybrids less sterile than the other four forms produced when crossed with this species.

After summarising the examples given above, and in the endeavour to draw deductions from them, one is prepared to

admit that matters may appear somewhat complicated. So diverse, indeed, do all these examples of hybridization appear to most writers in relation to the usual classification, that I am not aware that any recent authority has made any endeavour to put forward any theory on these matters. The best they seem to do, that is, the few who comment thereon, is to make some such statement as "we now know that hybrids are not by any means invariably infertile," while many others give no details or examples of such results as I have given above, nor even refer to the subject at all. Dewar & Finn * and Bartlett † certainly produce an array of instances, but apparently make no attempt to summarise or explain them, and they therefore leave the subject much the same as when they entered upon it.

Other writers touching on these matters explain that, whereas fertility was formerly considered to be the absolute test of a species, later investigations have discountenanced this theory. Such criticism is merely negative, and is very possibly far more unsound than the original belief which it condemns.

Many modern biologists are fond of drawing attention to the inviolability of the germ-plasm, which they explain is housed, guarded, and handed on from generation to generation, uninfluenced by and unaffected by all "indefinite variations," which are therefore not inheritable. To a certain extent only does this appear feasible. It seems altogether too strict and unplastic a way of putting matters, nor does it appear sound reasoning compared with Darwin's statement that environment and change of diet are the causes of evolution and differentiation of species. That these act on the germ-plasm seems probable, affecting it through the digestion and blood and inducing it, as the parent of the next generation (plasmatic and corporeal) to, as it were, initiate and stimulate these variations in the latter, to be in turn (the next generation) acted on in the same manner and urged further along the new path.

The seeming resultant that strikes one as produced by all this is a belief to a certain extent only in the immutabilty of the germ-plasm, in that it is not so vitally affected as the outward form, as shown by the "fluctuations" and "mutations"

* 'The Making of Species.' † 'Wild Animals in Captivity.'

which occur in species, and which are so apparent to the eye; no matter that the germ-plasm initiates these changes, or is affected by them (such as they are), they are more apparent than real, that is, as indicating any definite change in the parent germ-plasm, in so far as to any change in powers of interbreeding, conception, and the begetting of young. For instance, these "fluctuating" and "mutating" animals are almost invariably quite fertile with recent similar developments of each other, as shown by the interbreeding of some wild and all (as far as I know) domestic varieties. Therefore it seems feasible to suppose that the germ-plasm changes only gradually, as suggested by the results given in the table of hybridisation, showing the gradual reduction of fertility given above, and that there are not generally any sudden changes or "jumps" in this germ-plasm in the nature of anything akin to mutation, such as are visible as structural changes to the eye. If, as suggested by Weismann, the physiological unit of the germ-plasm is built up architecturally (any alteration in design may possibly be a later development denoting greater changes) or whether, as more recent investigators suggest, the changes are due chemically to ferments, it is still possible the change is a gradual one and rarely effected suddenly, even if, as De Vries holds, there are times of violent activity in the life of a species, during which it tends to throw off mutations. As far as I can reason, the examples I have quoted appear to be evidence sufficiently strong to show gradual changing of the germ-plasm (more or less rapid though it may be through such stimulating effects as changing environment and food), no matter how spontaneous or important the visible jump may be. I believe that the inward invisible germ-plasm relationship (which one might expect would be reciprocated in blood tests) is most generally the true evidence of relationship as opposed to that entirely founded on every structural difference, great or small. This does not mean, however, that structural evolution and germ-plasm changes do not go hand in hand, for it would seem that it is only generally in the closer relationship of the various groups that one, so to speak, gets ahead of the other.

For instance, let us assume two forms evolute out, both, perhaps, still largely feeding on the same substances, the evolu-

tion being caused through one taking to climbing, or swimming, or jumping. It is more than probable that the outward form immediately begins to adapt itself by harmonious development to the changed circumstances (such as the unique loss of a great toe development in the Patas Monkey and digitigrade walking), thus leaving the animals more related in blood relationship than they appear (though this is, perhaps, not well illustrated in the above example), through the internal essences being similar, or, at most, more gradually acted on in later generations through a change of diet on the part of the separating form.

It is in the adult Patas that the curious doglike form suggestive of high speed is most noticeable; the young do not show it so prominently. Hence I imagine the general want of comment on this special development.

One may deny the above divergence, that is, the apparent difference in the rate of evolution of germ-plasm and structure, but, although outward form and germ-plasm must be in real unison, one cannot deny that, if one drew up a classification based on germ-plasm affinity (which I have held in these notes is shown in results of hybridism), this classification would certainly be apparently opposed in many cases to the one of structural similarity, as in the instances that I have given; but that I believe that this opposition would be only apparent, and have nothing to do with the real harmony between germ-plasm and structure, I have in these notes tried to make clear.

One might imagine change of diet to be one of, if not the greatest factor in inducing evolution, and environment of importance chiefly in so far as it offers opportunity of this change. Effects of change of diet would, one might conjecture, in time affect, through the anabolic action of the chromatin, the internal economy and blood of the animal, and one might expect that its influence must begin to be felt before aught else.

In the case of the Horse and Ass the difference in form and habits seems more important than is generally supposed, and appears to contrast somewhat with the congeniality of the germ-plasm which results in conception. I might also remark here on an instance given earlier in these notes—on the differentiation of the Chaffinch groups from the other finches—that it is possible, instead of the view of the divergence given above, that through

the insect-eating proclivities of *Fringilla* a difference may have arisen in the germ-plasm of this group as compared with *Acanthis* and kindred genera, which causes the infertility between them, but that otherwise the relationship between *Fringilla*, *Ligurinus*, *Acanthis*, *Serinus*, &c., is co-equal. I do not think this view probable, however (although it might account for their readiness in pairing), but imagine the one I gave when commenting on this to be more correct.

It is hard to keep from what appears to be arguing in a circle, and arriving at the commencement of our argument again, and at the apparently opposite conclusion that the germ-plasm changes through diet, while the structural change may not occur, and that therefore the latter is, in such cases, the truer test of relationship, and that the usual methods of classification are correct. In this way, one might imagine a germ-plasmatic change, let us say, through diet, but there would seem to be no apparent necessity that there should invariably or of necessity be any great corresponding structual change, unless environment through adaptation ordered otherwise; and one might argue that this is indeed what one apparently finds in the above quoted cases of *Fringilla* and *Acanthis*. Allowing this, one may quite reasonably further contend that *Ligurinus* evoluted out further back than the separation of *Fringilla* and *Acanthis*, but through the similarity of food keeps a similar germ-plasm, but on account of some physical labour develops a diverse structure (powerful beak) for crushing larger seeds. The development being diagrammatically something as follows:—

FIG. 1.

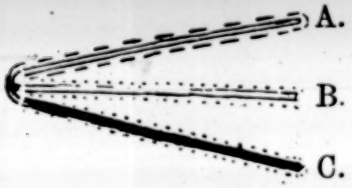
(Inner lines show germ-plasmatic, and outer lines structural similarities or changes.)

Where A and B retain the same fertility-producing plasm, from which C has diverged, structural changes being *vice versâ*.

And from this one might assert that *Fringilla* and *Acanthis* were more nearly related to each other than either to *Ligurinus*.

As before stated I do not hold this view, chiefly because the congeneric habits more than hint at a connection similar to that figured earlier in this paper. One feels, however, bound to bear this style of evolution in mind, and in the case of such an evolution of three species as figure 2, it would be hard to say which two of the species was nearer the third.

Fig. 2.



When I am speaking of structural changes, I wish to state that I do not imply by this any great structural change, but merely those minor differences that are generally credited as denoting generic divergence, or rather the lesser rank that generic modern divergence tends to assume.

If (going back to figure 1) we place *Anas* at A, *Aix sponsa* at B, and *Aix galericulata* at C, we may be on the track of the curious interbreeding results got from those forms, *Aix sponsa* hybridising more readily with the *Anatinæ* than it does with its apparently nearer relation *Aix galericulata*.

I cannot account for these anomalies unless it be by some such hypothesis as the above, or modifications of this by parallelism or convergence.

In using the term "relationship" for animals, it is necessary that we note clearly what we mean. In using this term "near relation" for human beings, we mean that those persons are nearer (genealogically) to a grandfather than to some remoter ancestor, that is, one farther back in the genealogical tree. It would seem that we ought not to so understand this term, when we apply it as meaning nearness or divergence in species.

For instance, in the case of the Porto Santo Rabbit. This animal is supposed to be descended from European Rabbits about the beginning of the fourteen hundreth century, being turned down on this island.

It is probable that the original ancestor of the European wild Rabbit and the English wild Rabbit are not connected

genealogically till hundreds of years before this, till perhaps before the time of the North Sea.

However, the Porto Santo Rabbit, isolated in a restricted environment, has apparently become very subject to evolutionary duction. It has apparently altered in habit, size, and structure, and now refuses to breed with ordinary Rabbits. One should say, therefore, that it is "further" in relationship to the Continental Rabbit than the latter is to the English, though genealogically this is by no means the case.

It is curious to note that this Porto Santo Rabbit, although it differs from the common type in all the above points, is but merely classified as a subspecies of *Lepus* (or rather *Oryctolagus*) *cuniculus*. What is the reason for this? None other, I should imagine, than the fact that we are unconsciously influenced by the fact that we know it has only evoluted out in the short space of six hundred years. Were this not known, would it not be held at least a distinct species? However, it seems absurd to liken the differences between this form and the common Rabbit to the usual small subspecial distinctions that generally hold good.

Are we not to consider different forms as different species because they have come quicker into being than perhaps often happens? If so, this strikes at the mutation theory.

(To be continued.)

LITHOBIUS LAPIDICOLA, MEINERT, A CENTIPEDE NEW TO THE BRITISH FAUNA.

By Richard S. Bagnall, F.L.S., F.E.S.

Whilst spending a short holiday in North Devon in August of last year (1913), I observed a smallish Lithobiid which occurred in the Ilfracombe district, amongst the larger pebbles and under stones at the foot of the cliffs at Hele Bay, the bathing cove, Ilfracombe, and at Lee Bay, where it was not only found on the shore but on the cliffs also. I could not identify it with any of our known British species and accordingly sent specimens to Dr. Brölemann, who with his customary kindness readily identified them as *Lithobius lapidicola*, Meinert, a South European species.

It comes in the group *Archilithobius*, and according to Latzel near to our species *calcaratus*, though Von Attems* places it in another subdivision, with *pelidnus*, *mutabilis*, &c.

L. lapidicola was described by Meinert in his 'Myriapoda Musæi Hauniensis,' ii., Lithobiini† in 1872, and a description will also be found in Latzel's 'Die Myriopoden der Oster.-Ungar. Monarchie.'‡

I regret that I have not yet found the opportunity of making a study of the species and therefore cannot, at present, offer any further remarks.

* "Die Myriopoden Steiermarks," Sitz. k. Akad. Wiss. Wien Math.-Naturw. Classe, civ. 1895, pp. 117-238.

† Naturh. Tidskr., viii. 1872, p. 228.

‡ I. Die Chilopoden, 1880, p. 106.

ON THE LOCATION OF THE SACCULUS AND ITS CONTAINED OTOLITHS IN FISHES.

By Colonel C. E. Shepherd (Indian Army).

Whilst as a rule every fish that has otoliths has six of them (three each side), in different families they are located in the head in different ways, and these are characteristic of the families. The otolith in the sacculus is the sagitta, the otolith in that portion of the sacculus known as the lagena is the astericus. In many fishes the position of the sagitta, the bone of the skull being very thin immediately under it, becomes apparent on removing the epibranchial arches and the adjacent tissues, the opaque body of this otolith showing distinctly through the thin bone. This, however, is mostly seen in the case of a fresh head; those that have been preserved in any way often lose this transparency of the bone, although in some cases it is retained. This transparency is not peculiar to any fish in particular, but is to be seen in many different families, whilst other members of the same family do not show it. It is to be observed in *Gadus merlangus* (the Whiting); in several of the *Pleuronectidæ* (the Flat fishes); in several of the *Characinidæ*, and many others which will be mentioned later on. In the cases where the sagittæ can be seen they are always inclined at an angle to the middle line down the length of the fish, the backward end of the otolith being nearer to the middle line and the end pointing forward being further away, so that a line drawn through the direction of the otoliths would make an acute angle with the middle line, the apex of the angle being directed backward. When the thickness or opacity of the basi-occiput does not permit of the sagittæ being seen, their position is often indicated by a more or less defined, prominent bulging of the bone on each side of the middle line. In some fishes the position of the sagittæ is shown by two bony excrescences on the under side of the skull, diverging from one another to suit

the divergence of the sagittæ. This is seen in *Antennarius hispidus*, a small-sized member of the Angler family from the Indian Ocean; in *Ophiocephalus punctatus*; and markedly so in *Anabas scandens* (the Climbing Perch of India), where the bony excrescences look like the buds on opposite sides of a twig just before they burst open. When the skull is opened by a vertical cut down the middle, the differences in the location of the sacculus can more readily be appreciated. In some fishes this lies nearer the eye orbit, in others it is further away. Again, in some it is close to the middle line of the head, in others it is away to the side of the skull; this is noticeable in the *Gobiidæ* (the Gobies); in *Tetrodon leopardus* (an Indian Globefish); and in *Anableps tetropthalmus* (the Four Eyes of Demerara). In the *Mormyridæ* (Nilotic fishes) quite a different arrangement to the usual one is to be seen. The sacculus is attached in *Mormyrus kannume* to a bladder-like termination of the swimming bladder, and is situated at the back part of the skull. In some families the sacculus is completely embedded in the basi-occiput bone, which has to be carefully split up to extract the sacculus and its contents. This is so in the *Characinidæ*, the *Cyprinidæ* (the Carps), and the *Siluridæ* (the Cat fishes); all belonging to the *Ostariophysi* suborder of fishes, *i.e.* those that have their swimming bladder connected with their hearing organs by means of a series of bony ossicles known as the "Weberian ossicles." In other fishes the sacculus with its enclosed otoliths, although embedded in a bony pocket, is not so solidly encased as in the *Ostariophysi*, and the opening where the junction of the sacculus with the utriculus is effected is more patent. In some this opening is small and the bony walls of the pocket have to be cut away to release the sacculus; in others the opening is big enough to allow the sacculus to be lifted out through it. Other fishes have the sacculus lying fairly open in a depression rather than a pocket, whence it can be lifted out with a pair of forceps and removed, a trifle of bone perhaps having to be cut away to release one or other end of the stone; this is so with *Gadus merlangus* (the Whiting). Again, the sacculus may be lying in the open on the floor of the brain cavity, it can be picked up and removed without further trouble; this is so with *Zeus faber* (the John Dory), and *Batrachus surinamensis* (the

Pacuma of British Guiana). Differing, then, as they do in the quantity of bone with which the sacculus is surrounded, there is also a difference as to the roominess of the bony pockets. With the *Ostariophysi* the sacculus fits compactly in the cavity provided for it, with no room for movement. In *Brama raii* (Ray's Bream, Couch), on the contrary, the cavity is much longer than the sagitta in its sacculus, and this could be moved backwards and forwards freely. In the *Sciæindæ* also the pocket for the sacculus is roomy. In those fishes having a well-defined lapillus, the third otolith, there is always a cavity in the skull for the "*Recessus utriculi*" to rest in, this being that part of the ear labyrinth holding the lapillus. Notably is this so in the *Siluridæ*, to accommodate what in some of this family is a very large stone; this cavity is well-defined on the outside by a bulging-out of the bone of the skull: this is clearly seen in *Arius spixii*.

To get a more definite idea of the location of the sacculus and of the otoliths it will be as well to take the families *seriatim* of such as have been available for examination.

Polypteridæ.

Polypterus senegalus has the pocket for the sacculus high up at the side of the skull and open; the sacculus could be extracted with a little manipulation without cutting away any bone. In this fish the asteriscus* is the largest of the three otoliths.

Acipenseridæ.

Acipenser sturio (the Sturgeon). In this fish the sacculus contains otoconie as well as a solid sagitta.

Amiidæ.

Amia calva (the Bowfin of North America) has the asteriscus as the largest of the three otoliths on each side. The location of the sacculus and its contents is shown from the outside by a swelling on the basi-occiput of thin shiny bone. The sacculus and labyrinth of the ear are situated in a recess separated from the brain in the cranial cavity by a diaphragm of cartilage. The sacculus is in two well-defined portions, the lagena, the posterior and larger one, holding the asteriscus (fig. 8, p. 109).

* Figured in the 'Zoologist' (vol. xiv., p. 294, pl. ii. f. 5).

Lepidosteidæ.

Lepidosteus osseus (the Long-nosed Garpike of North America) has a well-defined pocket for the sacculus at the side of the head, The sagitta* in this fish is the largest otolith.

Ceratodontidæ.

Neoceratodus fosteri, called the Burnett salmon, another name being the Dawson salmon of Queensland, Australia. This, the only living example known of this family, has no indication on the lower side of the skull showing the location of the sacculus; but at the top of the skull two prominences show, when the skin is taken off, that indicate the upper part of the vertical semicircular canals of the labyrinth. In the specimen examined there were only four otoliths found, two on each side. An illustration of them is given natural size (fig. I., 1, p. 107). The two upper ones are from the right side of the head, the two lower from the left. The lapillus is the upper one of each set, the other being the sagitta. These otoliths are very chalky-looking and not so porcelain-like as in teleostean fishes. The texture can be compared in the photograph with those shown (fig. I., 3 and 4).

Lepidosirenidæ.

The otolithic material in the head of *Lepidosiren paradoxa* is in the shape of dust, otoconie.

Elopidæ.

Megalops atlanticus (the Tarpon) has the sacculus lying in a bony pocket fitting the sagitta closely, with a distinct pocket for the lagena portion of it. The lagena itself is well developed and holds a fair-sized asteriscus. The pocket for the sacculus is open at the top.

Albulidæ.

Albula conorhynchus, the specimen secured, came from Java; the site of the sacculi is shown by two prominent swellings under the basi-occiput. The sacculus is not embedded in a bony pocket, the sagitta could be easily lifted out. It is large for the size of the fish.

* See 'Zoologist' vol. xiv., p. 294, pl. ii. f. 6.

Mormyridæ.

In this family the sacculus is at the back of the skull, to one side, away from the middle line and separated from the cavity holding the brain by a diaphragm of a thick skin-like substance. The ear membranes are attached to an ovoid-shaped bladder, a prolongation of the swim-bladder. The whole arrangement is totally different from that of any other family of fishes. This is

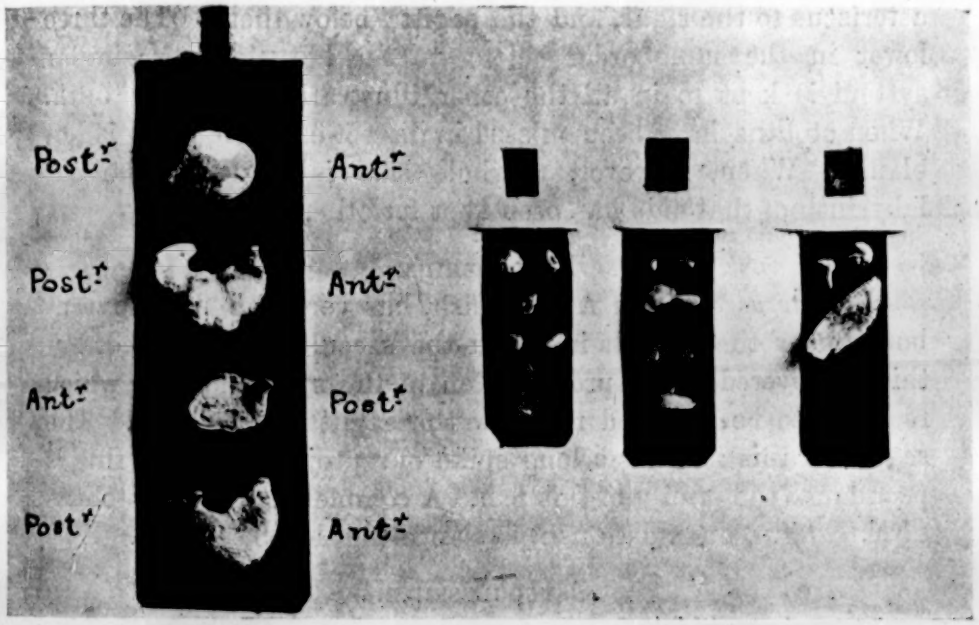


Fig. I.

1. Neoceratodus fosteri. 2. Hyodon alosoides. 3. Osphromenus olfax. 4. Otoliths from right side only of Polynemus tetradactylus.

seen in *Mormyrus kannume*, *Hyperopisus bebe*, and *Marcusenius isidori*, all from the Nile River. In *Mormyrus kannume* the lapillus is the largest otolith of the three (fig. II., 11, p. 109). It is, however, nearly equalled by the astericus. The length and breadth of the two are nearly equal, but in thickness the lapillus is the greater, the astericus being, as is usual with this stone, comparatively thin.

Hyodontidæ.

Hyodon alosoides (the Mooneyes of Canada) has no outside evidence of the position of the sacculus as far as the bones of the skull are concerned; but it may be noted that the sacculus lies

just under the forward end of a white leathery tissue forming the end of the swim-bladder, where this is connected with the ear labyrinth. The sacculus is embedded in a bony pocket which requires cutting away. The lagena lobe of the sacculus is larger than the front portion, the astericus being larger than the sagitta. The lapillus, however, in this fish is the largest of the three otoliths (see fig. I., 2, p. 107). The upper three are from the right side of the head, the lapillus being to the left, the asteriscus to the right, and the sagitta below them. The three lower in the same order belong to the left side. A similar system is kept to in all the other illustrations of the otolith. When otoliths have been missed in dissection their place is left blank. When, however, a whole side is wanting, the ear labyrinth of that side has been kept for other purposes.

NOTOPTERIDÆ.

Notopterus afer, an African fish, has very thin transparent bone under the pockets in which the sacculus is contained, but this is covered by a prolongation of the swim-bladder, which requires to be removed to allow the sagittæ to be seen. The sagitta of this fish has a long spike of a projection to it; this is peculiar to the family of this fish. A complete set of the otoliths of *N. kapirat*, an Indian fish, is shown (fig. II., 3, p. 109).

OSTEOGLOSSIDÆ.

Osteoglossum bicirrhosum (the "Aroowana" of British Guiana) has no external indication to point out the location of the sacculus. It is much enclosed in bone, which has to be split up and cut away to obtain the sacculus and its contents.

PANTODONTIDÆ.

Pantodon buchholzi, an African fish of small size, has a fairly large and solid sagitta; it is shown (fig. II., 9, p. 109).

CHIROCENTRIDÆ.

Chirocentrus dorab, from the Indian Ocean, gives no indication from the outside as to the situation of the sacculus. It is much embedded in bone.

CLUPEIDÆ.

Clupea harengus (the Herring) has its sacculus lying in a bony pocket that has to be cut away to get the sacculus out.

The same with *C. finta* (the Twaite Shad) and *C. ilisha* (the "Hilsa" of Bengal, but called "Pulla" in Scinde).

SALMONIDÆ.

Neither in *Salmo salar* (the Salmon) nor in *S. fario* (the Trout) is there any external indication of the situation of the otoliths. In the latter fish the pocket is open at the top, the sacculus could be lifted out without trouble. In *Osmerus eperlanus* (the Smelt) the sacculi are covered by two little ovoid

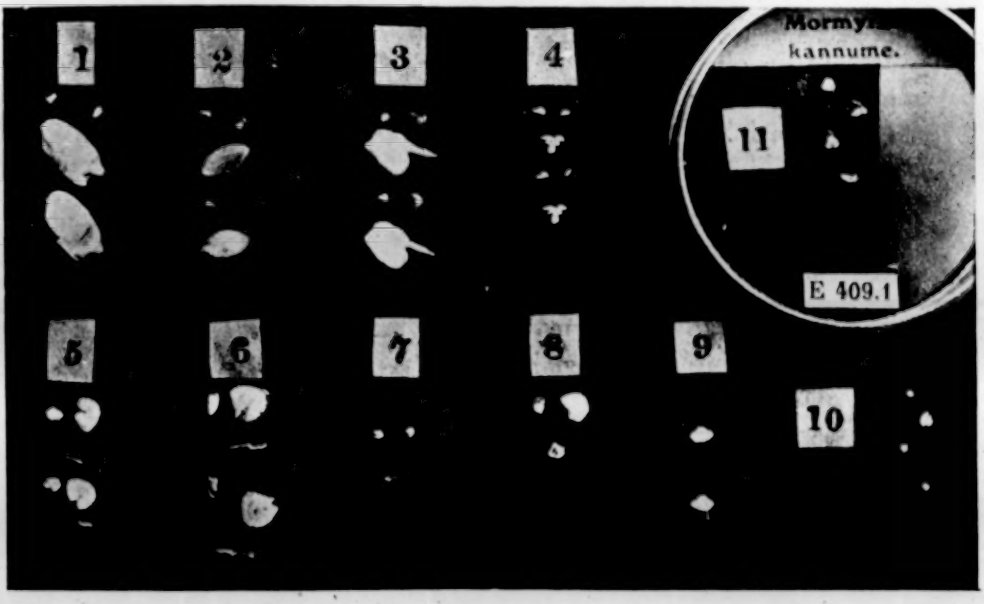


FIG. II.

1. NEBRIS MICROPS. 2. ANABAS SCANDENS. 3. NOTOPTERUS KAPIRAT. 4. ZEUS FABER. 5. ERYTHRINUS SALMONEUS. 6. MACRODON TRAHIRA. 7. PLECOSTOMUS BICIRRHOSUS. 8. AMIA CALVA. 9. PANTODON BUCHHOLZI. 10. BALISTES CAPRISCUS. 11. MORMYRUS KANNUME.

lumps of thin bone on the under side of the basi-occiput, which allow the sagittæ, large for the size of the fish, to be seen.* *Salvelinus willughbii* (the Charr) has no external indication of the situation of the sacculi. The basi-occiput has two swellings on the under side, but dissection reveals that they only cover the muscle actuating the eyeball. The sacculi really lie above this muscle. The cavity containing the otolith is open at the top, and the sacculus can be lifted out without cutting away of bone.

* *Salmo salar* and *Osmerus eperlanus* are figured in 'Zoologist,' vol. xiv., p. 293, pl. i. 13, 14.

(To be continued.)

NOTES AND QUERIES.

AVES.

Status of Blackcap and Garden-Warbler.—With regard to the correspondence on this subject, I can state that here, a few miles west of Lincoln, in my experience, the Garden-Warbler is far commoner than the Blackcap. I have frequently noted the fact.—F. L. Blathwayt (Doddington Rectory, Lincoln).

Status of Lesser Whitethroat.—Referring to Mr. Gill's remarks (*ante*, p. 36) regarding the status of the Lesser Whitethroat, I quite agree that the distribution of this species as given in most ornithological works is very imperfectly mapped out; this, no doubt, is owing to its having been confused with two or three other species of Warblers. Gilbert White mentions a "rare, and I think a new, little bird frequents my garden, which I have great reason to think is a Pettychap. It is common in some parts of the kingdom. This bird much resembles the Whitethroat, but has a more white or rather silvery breast and belly, is restless and active, like the Willow-Warbler, and hops from bough to bough, examining every part for food; it also runs up the stems of the crown-imperial, and putting its head into the bells of the flowers, sips the liquor which stands in the nectarium of each petal," which was evidently referable to this species; and it is quite obvious that much confusion existed in the mind of the late A. G. More when he wrote his work on the distribution of birds during the breeding season; and in the Yorkshire records by Thos. Allis, many of which are extremely doubtful. This species appears to be less common and more restricted in its distribution in the western than in the eastern half of England, but even in the eastern counties it is very irregularly distributed, and the same remarks would apply to Wales. It is said, however, to be fairly common in some parts of Cheshire and also in Derbyshire, which has not been my experience regarding its status in the latter county, but my visits have been comparatively short, consequently my observations on that account may not be so valuable as more prolonged sojourns would have been. My visits have been chiefly confined to the

Peak District, the general physical features of which are very similar to North-west Yorkshire, and such conditions are not suitable habitats of the Lesser Whitethroat, at least in its Yorkshire range. In this district (Wilsden) I have only three occurrences for over forty years; twice it has bred, and, curious to say of both instances, almost in the identical bush in the Aire Valley, near Bingley. It is said to be an early breeder—much earlier than the Whitethroat—but I think this is a mistaken idea. It seems to prefer feeding among the higher branches of trees than the commoner species. Even to the seventies very little was known regarding the distribution of this species in Yorkshire, and it is to be feared that much confusion exists at the present time. In the north-west of Yorkshire it is a very rare nesting species. Morris says it is found near Halifax, but probably he copied his statement from the source which supplied Thos. Allis with his information. It is, however, hardly probable that the Lesser Whitethroat will be commoner there than in this district. In some districts to the east it is fairly common, or at least not rare, *viz.*, about Neatherby, Thorp Arch, and Boston Spa, whilst in the neighbourhood of York it is said to be more abundant than *Sylvia cinerea* (Nelson); further south-east, about Beverley and the Holderness district, it is more sparingly distributed. It is not uncommon in the Huddersfield district, but is said to be absent from the district of Sheffield, although Thos. Allis reported it as common in 1844, and it is also absent from the neighbourhood of Flamborough Head. It is sparingly distributed in some of the valleys in the neighbourhood of Whitby, and the same remarks apply to Staithes and Loftus, in North Yorkshire, and it is a summer visitor to Marske and Ellerton, in Swaledale. It breeds but locally in some parts of Wensleydale, and was considered a rare bird about Wakefield until the year 1870, but this might be on account of its having been overlooked or confused with some other species—a common mistake up to within a recent date; the Lesser Whitethroat is not included in the list of birds of Washburndale by Roebuck and Clarke, nor in the list of birds of Langstrothdale by Wood. Much remains yet to be known of its range in Yorkshire. This, however, is certain, that it is a rare breeding species in North-west Yorkshire, and nowhere can be called abundant except in the central plain. Personally I have never met with this species more commonly than its near ally *cinerea* in any part of Yorkshire.—E. P. BUTTERFIELD.

Waxwings in Yarmouth and the Neighbourhood. — Unusual numbers of Waxwings (*Ampelis garrulus*) have visited the east coast

during the present winter, six having been seen at Yarmouth, four in the adjoining parish of Caister, and several others in the neighbourhood. I received three examples from Runham, about four miles from here, one on December 20th and two on the 24th. The first of these was a very fine specimen, having wax-like appendages on the tail, besides seven on each wing. These appendages are very rarely seen on the tail; this circumstance probably not occurring more than once out of twenty examples. On the wings the red tips vary in number from three to seven, according to sex and age. One bird taken at Yarmouth had no sign of red on its wings, and the band across the tail was a greyish white instead of yellow. I should think this is the record season for this species.—B. Dye (Yarmouth).

Waxwings (Ampelis garrulus) in Bedfordshire.—The first reported occurrence of the Waxwing in Bedfordshire during the past winter is given in the 'Bedfordshire Times and Independent' in its issue of December 19th, wherein one is mentioned as having been shot near the River Ivel at Biggleswade. On January 20th one of two was killed in a garden along the Clapham Road, in the borough of Bedford; the other that was in its company has been seen in the same grounds several times since. Another was obtained at Colworth House, Sharnbrook, on January 22nd. The previous known occurrence of Waxwings in this county was one obtained early in 1904, killed in the Bedford Cemetery. Earlier records were in the winters 1882–83, 1884–85, 1889–1890, 1892–93, 1894–95.—J. Steele Elliott (Dowles Manor, Shropshire).

The Little Owl Breeding in Somerset.—On May 24th of last year I had a set of five eggs brought to me taken the same day by a farm labourer at Doulting; he said they were Owl's eggs, and that he had taken them from the decayed head of a pollard elm tree. The eggs puzzled me, for although they were almost identical with some eggs of the Little Owl in my possession, I could not say with certainty they belonged to that species: I mentioned the matter to a few friends in the locality who promised to keep a look-out for any strange Owls. During the past autumn Mr. Arthur Elton saw a small spotted Owl flying about the fields close to the ground, pitching here and there on low branches of trees, and on February 3rd last he shot one close to his farmyard at Bodden, a mile or so from Doulting, and brought the bird to me on February 4th; it was without doubt *Athene noctua*. I sent it to Mr. W. J. Clarke, of Scarborough, to be set up, and the following are his notes taken on dissection:—Adult female, eight and three-quarters of an inch in length and six inches

and a quarter from the carpal joint of wing to longest primary, weight five ounces and a half; its stomach contained a few small pellets of the hair of some small mammal, and the hard portions of a single small beetle. I now conclude that the eggs mentioned above are genuine eggs of the Little Owl, and that this species breeds in this particular spot on the Mendips, about two miles north-east of Shepton Mallet. This is, I think, the first discovery of its breeding in Somerset, but not of the presence of the bird. I may add that it was not my wish this bird should have been shot, and Mr. Elton has promised not to shoot another, should one happen to come in range.—Stanley Lewis (Wells, Somerset).

Iceland Gull in Co. Mayo.—On January 27th an Iceland Gull (*Larus leucopterus*) in immature plumage was shot on the island of Bartragh, Killala Bay, by Miss Kirkwood. When leaving the house for the shore, she saw it flying slowly past, and pitching on the strand a couple of hundred yards away it began feeding. Having her light gun with her, she immediately commenced stalking the bird, and coming within range fired, knocking it over, but as it was only winged she has kept it alive, in the hope of taming it and curing its wounded wing, and if successful intends sending it to the Zoological Gardens, Dublin.—Robert Warren (Ardnaree, Monkstown, Co. Cork).

OBITUARY.

Dr. Albert Günther.

At the request of the Editor of this Journal I have to offer to its readers a brief obituary notice of the late Dr. Albert Günther, a task congenial to one who was associated with him for many years, in fact, during the greater part of the period 1856 to 1895, when he was connected with the British Museum.

It will not, however, be on account of the position he held in that Institution that he will be known to future zoologists, but by the extent and character of his voluminous writings.

From an authoritative source we are informed that he was born at Württemberg on October 3rd, 1830, and was educated at Stuttgart Gymnasium, and at Tübingen, Berlin and Bonn Universities, obtaining the degrees of M.D., M.A., and Ph.D.

At the conclusion of his University courses he visited London, and his services at the Museum commenced in 1857, being first employed on a 'Catalogue of Colubrine Snakes,' published in 1858, and extending to nearly 300 pages. In the same year was issued his 'Catalogue of Batrachia Salientia,' pp. 176, with 12 plates. He then commenced his great work the 'Catalogue of Fishes,' completed in eight volumes. These comprised over 4000 pages with text figures, and occupied most of his time during the next twelve years. In 1877 was issued his 'Account of the Gigantic Land Tortoises' (living and extinct), containing 96 pages of text and illustrated with 55 plates.

His report on the Reptilia, Batrachia and Fishes from Melanesia, and Reptilia from the Western Indian Ocean, obtained by H.M.S. 'Alert,' was published in 1884. The foregoing constitute practically all the works published by the Museum, of which he was author.

His other chief writings are:—'Die Fische des Neckars,' 1855; 'Handbuch der Medicinischen Zoologie,' 1858; 'The Reptiles of British India,' 1864; 'The Fishes of Zanzibar,' 1866; 'Description of Fishes from Vancouver' in J. K. Lord's "The Naturalist in Vancouver Island and British Columbia," Appendix, 1866; in the Appendix to vol. ii. of 'Mouhot's Travels in the Central Parts of Indo-China,' &c., "Lists of New Species of Mammalia, Reptiles and Freshwater Fishes," 1864; 'The Fishes of the Nile' in Petherick's "Travels in Central Africa," vol. ii. Appendix, 1869; 'Reptiles and Fishes of the South Sea Islands' in Brenchley's "Cruise of H.M.S. 'Curaçoa'," 1873; 'A List of the Saurians of Australia and New Zealand' in the "Zoology of the Voyage of H.M.S. 'Erebus' and 'Terror'," vol. ii. 1875; 'Fishes from the Arctic Regions' in Nare's "Narrative of a Voyage to the Polar Regions," vol. ii. Appendix 4, 1878; 'Die Fische der Südsee,' 1873–1910; 'Introduction to the Study of Fishes,' 1880; 'Shore Fishes of the "Challenger" Expedition,' 1880; 'The Deep Sea Forms,' 1887; and his 'Account of the Pelagic Species,' 1889; 'Description of Fishes from the Arctic Regions' in Markham's "A Polar Reconnaisance—Voyage of the 'Isbjörn' to Novaya Zemlya," Appendix i. 1881; 'Herpetology of Matabale Land' in Oates's "Matabeleland and Victoria Falls," Appendix iii. 1881; 'Report on the Fishes' in Tizard and Murray's "Exploration of the Faroe Channel in 1880 in the 'Knight Errant'," 1882; 'On the Reptilia and Batrachia' in Godman and Salvin's "Biologia Centrali-Americana," 1885–1902; 'List of Reptiles and Fishes collected on the Upper Yang-tze-kiang,'

&c., in Pratt's "To the Snows of Tibet through China," Appendix ii. 1892; 'Report on a Collection of Fishes made during an Expedition to Lake Rudolf' in A. D. Smith's "Through Unknown African Countries," Appendix A, 1897; 'Report on a Collection of Reptiles and Fishes made on the Ogowé River and in Old Calabar' in M. H. Kingsley's "Travels in West Africa," Appendix iii. 1897.

In addition to the foregoing more or less extensive productions, he was the author of very numerous papers published in the journals of the Royal, Linnean, Zoological, and other Societies, and in other periodical publications. As many as three hundred can be attributed to his pen. The whole of his writings occupy some ten thousand pages, illustrated by a very large number of beautiful plates and text figures. He was also one of the editors of the 'Annals and Magazine of Natural History' from 1875 to 1912, and edited the first six volumes of the 'Zoological Record,' 1864–69.

This will give the reader an idea of the literary work accomplished by Dr. Günther; but it must be remembered that for twenty years (1875–95) he was Keeper of the Zoological Department, and the amount of administrative work connected with that position is only known to those who have served immediately under him. The supervision of his staff, the preparation of numerous reports in connection with the individual members of the staff, monthly and annual reports of progress and work accomplished, the supervision and editing of catalogues and guides issued by his Department, besides the consideration of all proposed acquisitions, and the attending to considerable correspondence continually arriving—these are only the principal duties which came to him as Keeper. It is, indeed, surprising that he found time during that period to publish the important works and treatises which issued from his pen.

Dr. Günther was in a great measure responsible for the careful removal in 1882–84 of the Zoological Collections from the British Museum in Bloomsbury to South Kensington, a very considerable undertaking, which was accomplished practically without injury to any of the specimens. He also to a great extent directed their subsequent rearrangement in the building where they are now displayed.

At Dr. Günther's recommendation the building at present containing the immense collections preserved in spirit was erected. The formation of the general and zoological libraries resulted also from his recommendation, and he was especially proud of having got together the groups of British nesting-birds, with their natural

surroundings, which have proved of such interest to the general public.

Mainly through Dr. Günther's recommendation the National Museum is indebted for the possession of many valuable collections of the greatest scientific interest. Among these may be mentioned the following:—The Gould collection of Birds, Baly collection of Phytophaga, Bates collection of Heteromera, Zeller Lepidoptera, the Keyserling Arachnida, Frey Lepidoptera, the Moore Indian Lepidoptera, the Atkinson Coleoptera and Rhynchota, the Saville-Kent Corals, Parker Foraminifera, Pascoe Coleoptera, Morelet Land and Freshwater Shells, Captain Shelley's African Birds, Godwin-Austen's Indian Birds, the Oates collection of Birds of Pegu, the Sclater collection of Birds, the Grote North American Lepidoptera, and many other minor collections.

Many most important additions to the Museum collections were acquired by presentation during the same period, and in some cases it was doubtless owing to Dr. Günther's tact and urbanity that these donations were received.

Many honours were conferred upon him by various societies both at home and abroad. He was elected Fellow of the Royal, Linnean, and Zoological Societies, and filled the offices of Vice-President of the Royal Society (1875–76), and President of the Linnean Society (1898–1901). He was recipient of the Royal Society's gold medal in 1878, and also that of the Linnean Society in 1904. In 1880 he was President of the Biological Section of the British Association.

On the authority of one eminently qualified to express an opinion on the zoological work accomplished by Dr. Günther, it can be stated without fear of contradiction that he was the foremost ichthyologist of his day, and his *magnum opus*, the 'Catalogue of Fishes,' has never been replaced by any similar comprehensive work. His writings on the Reptilia were also on the same high level.

Dr. Günther was a man with a strong personality, but with all his firmness of disposition he ever maintained a friendly relationship with those associated with him in the work of the Museum, and when freed from that official relationship he at once became the most pleasant of personal friends, of whom he had a very wide circle.

He was twice married, and leaves a widow and two sons to mourn his loss. His death took place this year on February 1st in his home at Kew, and he was buried at Richmond in the presence of those he loved and many sorrowing and devoted friends.

E. A. Smith.

Major Barrett-Hamilton.

Gerald Edwin Hamilton Barrett-Hamilton, only surviving son of the late Capt. Samuel Barrett, who, in 1887, assumed the additional name of Hamilton; of Kilmanock House, Campile, Co. Wexford, was born 1871; educated at Harrow and at Trinity College, Cambridge, where he graduated B.A. in 1894, taking a First Class in the Natural Science Tripos, in the same list with his friend Dr. Edward Adrian Wilson, who was afterwards to become the artist to Barrett-Hamilton's great book on the British Mammals. Called to the Bar at the Inner Temple, 1896; in May of that year, with Professor D'Arcy W. Thompson (now C.B.), he visited the Fur-Seal Islands of the North Pacific on behalf of the Foreign and Colonial Offices, with a view to the investigation of the Natural History of the Northern Fur Seal, "with special reference to certain disputed points which have a distinct bearing on the industry connected with the skins of the animal."* While the Professor proceeded direct to the Pribiloff Islands, Barrett-Hamilton had instructions to visit the Commander Islands (near the coast of Kamchatka). Later they proceeded together to S. Paul Island, the largest of the Pribiloff group, returninn home at the beginning of the next year. Barrett-Hamilton had formed a collection of small mammals, together with specimens of the Northern Fur Seal, a series of skulls of Steller's Sea-Lion, and a skin which was mounted for the National Collection at Cromwell Road. There were also fair collections of birds, fishes, and invertebrates.

He served in the S. African war, 1901–2, in the latter year being gazetted an Hon. Captain in the army. In 1903 he married Maude Charlotte, only daughter of F. S. Eland, Esq., of Ravenshill, Transvaal, who survives him, together with six young children. Served as High Sheriff for Wexford, 1904. In 1905 he was promoted Major of the 5th (Militia) Battalion (Special Reserve) Royal Irish Rifles; elected F.Z.S. and M.R.I.A.

Between 1898 and 1904 he gave numerous lectures in all parts of the United Kingdom on different subjects connected with the mission, including papers before the British Association in 1898 and 1899.

His report on the Behring Sea Mission was so well received that he gained special recognition from the Government; and later was asked to report on the collection of mammals made during the

* 'Proc. Zool. Soc.,' 1897, p. 190.

Antarctic voyage of the 'Southern Cross.' * Previously to this he had applied (as he has himself told us in his "Appreciation of Dr. E. A. Wilson," published with part xiv. of his 'History of British Mammals' in August, 1913) for appointment to the scientific staff of Scott's first Antarctic Expedition (1901–4), when Wilson was selected, doubtless on account of his marvellous skill as an artist, combined with his qualifications as a doctor; while to Barrett-Hamilton fell the honourable task of compiling for the use of the expedition the chapter on Seals in the 'Antarctic Manual' (1901).

There is something singularly pathetic in the coincidence of the author pausing during the publication of his principal work to write an appreciation of his artist who had perished in the Antarctic; and only five months later the publishers again pausing while a similar sad office is performed by an old friend (Mr. Oldfield Thomas, F.R.S.) of the author, who has now himself died on what may be called the threshold of the same Antarctic.

He maintained a weekly correspondence from his Cambridge days until his death in 1907 with Professor Alfred Newton, who took the greatest interest in and guided his career, and who always regretted that his life was not wholly given up to zoology. His output of papers and notes on all branches of zoology was very large, but space does not allow an extended notice of them.

Early in 1904 Barrett-Hamilton "approached" the present writer by asking if he could supply certain specimens of British mammals for the National Collection at South Kensington, but in his third letter he divulged his real object:—"I may as well tell you straight out that I have accepted the invitation of the owners of Bell's 'British Quadrupeds' to bring out a new edition of the work, and I am very anxious that it should be as good and up-to-date as possible. That is why I am anxious to obtain reliable information upon the moults, periods of gestation, &c., of the smaller and rarer carnivora, on which points I believe that no one has anything like the knowledge which you have." Correspondence on a subject so congenial to both of us once started, has flowed ever since, generally with very short intervals, ending only with his lamented death, ten years later. Another quotation or two will help to show the early stages of the work, though not by any means its inception, because from his youth he had cherished the idea, and his preparations began early.

* "Report on the Collections of Natural History made . . . during the Voyage of the 'Southern Cross.'" Mammalia. 1902. Sold at the British Museum Natural History.

A few days after the last letter quoted from, he wrote:—"Certainly no one would do a perfect book, but there is room for more accuracy and detail than has already been placed before the public." Ten days later:—"What I think I shall most need your assistance in regard to are certain small matters. . . . Then again, if you can favour me with a general criticism of my work when it takes shape, I shall of course be very grateful. . . . I hope presently to send you some draft MSS. on *Mustelidæ*."

Considerations of space preclude many quotations, and it must suffice to record that the first part of the great work eventually appeared on October 18th, 1910, and that since then the present writer has read every proof, making every kind of criticism and suggestion that seemed to him improvements, with frequent consultations and discussions, Barrett-Hamilton proving a charming person to try to help, because he was always so grateful, and (what was even more to the point) because he adopted a very large proportion of the suggestions!

On July 10th, 1913, he wrote:—"I wonder if you will be surprised or shocked when I tell you that I have accepted a mission from the Colonial Office to go and study the whaling at South Georgia. I couldn't refuse it, . . . and it is a beautiful trip *viâ* Portuguese ports. . . . I am much troubled about my 'British Mammals.' . . . I count that the knowledge which I shall get on Whales will more than recompense the book for any slight 'hold up,' and I am hoping to use my spare time in writing the Whale parts of it. It's most curious that fifteen years ago they should have sent me to Kamchatka, which no one had ever heard of, and now to South Georgia, which is nearly as bad in the opposite direction. But I am a lucky naturalist to get these trips. . . ."

Writing at sea on his passage out, on October 15th last (posted at Cape Verdes), he begins a long letter:—"The world is very small! Here I am, sailing to South Georgia under your old friend of the Finland [= Finmarken] whaling days, Capt. I. Bryde,* who sends you his best respects! Your volume of reprints [= of Whaling Reports] has been of the very greatest use to me, as I hope you will be glad to hear. I have been abstracting information from it the last few days, and in some respects your statistics are the most valuable I can find. I hope to use them for comparison with those to be obtained later

* *Vide* "Reports on Finwhaling off Coast of Finmarken," 'Zoologist,' 1886–1890, and his father in those published 1884–85. Also 'Saga Book of the Viking Club,' 1895–6, vol. i., p. 322.

on in South Georgia. I hope you will be kind to me about my 'Mammals' while I am away."

After a passage of thirty-five days, he reached South Georgia, accompanied by an assistant from the Natural History Museum. On December 2nd he wrote again, "for post as opportunity offers," another long letter about Whales, enclosing elaborate analyses compiled from the above-mentioned Reports in the 'Zoologist' (1884–90). He adds:—"I haven't seen a great many Whales yet, only a few (of each) Finners, Humpbacks, Blue and Sperm; but the notes which I have been able to make support or amplify yours. . . . I arrived here on November 10th. I find the place most interesting—Sea Elephants, Sea Leopards, Weddell's Seal, four or five kinds of Penguins, Albatrosses, and numerous *Procellariidæ*, all to be studied, besides the Whales, but at present I am chiefly engaged with the latter. I haven't time to write a full account, as when there are Whales on the platform I am there from 6 a.m. Some days the weather is charming, and of course we have the summer sun, but it blows and snows frequently, and there is little vegetation yet."

This letter was received on January 14th, and on the 17th occurred his apparently almost sudden death from heart failure.

The melancholy news was conveyed from South Georgia to the Falkland Islands by a whaler, a run which occupied a week. Another week was occupied by a cablegram thence to South Kensington; and from there the sad fact, lacking of course all details, was communicated to Mrs. Barrett-Hamilton, who has since heard that his body is being brought home by the whaler 'Orwell,' due at Liverpool about February 27th, so before this appears in print he will no doubt have been laid to rest near his Wexford home.

One would wish to write much more about him, who always believed the best of everyone, but already the limit of space is considerably exceeded.

ALFRED HENEAGE COCKS.